Optimization the UHP lamp flicker effect

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Abstract

Light flicker is a notorious phenomenon influencing light quality. The flicker of the light flux outputs from the light sources perceived by human eyes depends upon the lamp brightness fluctuations for projector display. This paper describes a ballast ignition control system, which makes the lamp strike frequency phase lock the blanking time period to minimize the flicker effect

Keyword: Flicker, Frame rate, Projector, Lamp

1. Introduction

Recent years projection systems with modern technology have attracted lots of attentions because of their excellent picture quality, resolution, ultra-high intentions and broad bandwidth. The most popular application in LCD (Liquid Crystal Display), DLP (Digital Light Processing) and LCOS (Liquid Crystal on Silicon) projector is to project the video output onto a screen. Conventional projector lamps are metal halide lamps (MHL), which fail to provide sufficient luminance projector systems for high brightness and have been replaced by the ultra high performance projector lamps (UHP), originally invented for ultra high intensity. The life times of the UHP lamp is three times longer than that of MHL [1] [2].

The UHP lamp used in projectors is one kind of the HID lamps, which are commonly recognized as the most efficient lighting source for higher brightness applications. The UHP exhibits negative resistance characteristics operated at high frequency. Due to its short arc gap, the UHP lamp resembles a point-like lighting source. A ballast is needed to generate sufficient high voltage to strike the lamp and to regulate arc currents. Electronic ballasts are widely used because of their high luminous efficiency, small size and lightweight [3].

However, UHP lamps operated at high frequency may cause flicker problems. This phenomenon can result in unstable arc. In order to reduce the flicker, the paper

Fig. 1 Set-up for measuring lamp flicker

describes a feedback control strike frequency system to minimize flicker effect.

2. Measurement Principle and result

"Blinking" that appears on the display under certain conditions is called flicker. Since flicker occurs periodically, it has an adverse effect on the user's eyes. It is obvious that the intensity level changes periodically and the larger its amplitude the more clearly the flicker is recognized.

Two kinds of quantifying measurement methods are available: contrast method and JEITA method. The contrast method is possible with the CA-210 and Flicker Measuring Probe (CA-P12/15) as show in Fig. 1.

Contrast Method:

If the intensity level of the display changes as Fig.2, it is considered that AC component (b) overlaps on the DC component (a). With the contrast method, the ratio of AC component to DC component is defined as the flicker amount. AC component (a) is defined as Vmax － Vmin and DC component (b) as

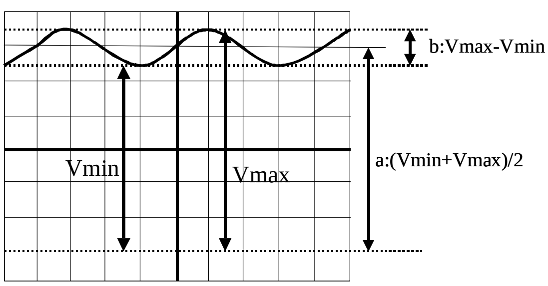

Fig.2

(Vmax＋Vmin) / 2, and the flicker amount is calculated by the following formula (1).

Flicker amount ＝ AC component / DC component

=(Vmax－Vmin)/{(Vmax+Vmin)/2}×100% --- (1)

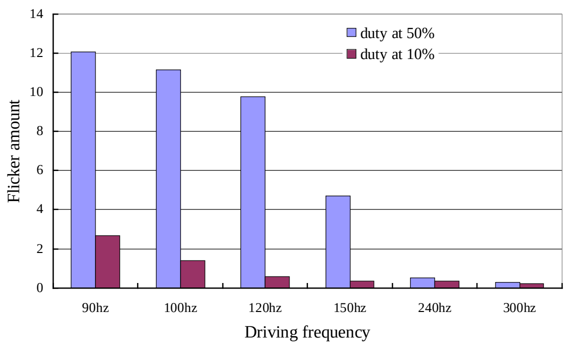

Fig.3 shows the flicker v.s. control frequency

Fig.3 shows the measurement result. The scheme illustrated a lamp flicker depend upon the ignite signal frequency.

3. Electronic circuit model

Fig.4 illustrates a lamp drive method and the associated light modulation. The lamp irradiation is synchronized to a blanking time of display frames. The lamp driving current is illustrated with respect to time for display frames. As shown in Fig.4, the current is pulsed just before polarity inversion at the beginning of each frame. The driving frequency can be muti-frme periodicity with each frame rate. The brightness fluctuation can be minimized during this frame time.

The diagram of Fig. 5 shows the control system model. We utilize the feedback of vertical synchronized signal of display and lamp enable signal into a phase lock loop (PLL) so that the output the ignite pulses will correspond to the blanking time of frame rate. This brightness variation can be optimized by this method.

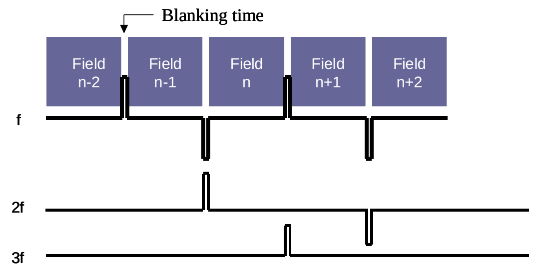

Fig.4 Drive scheme and associate light modulation

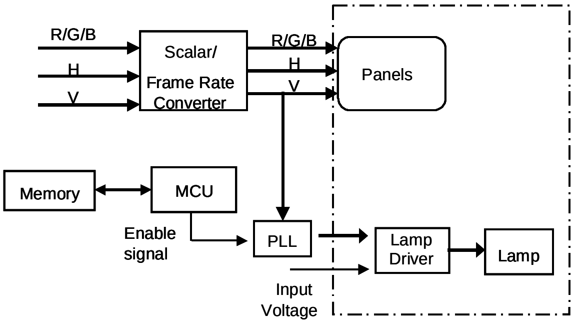

Fig.5 Block diagram of lamp driving control system

4. Conclusions

The UHP lamp flicker measurement data results show that lamp flicker depends upon the manipulation of the strike frequency.

The strike method and apparatus that we proposed in this paper make the lamp ignition periods lock the frame rate when lamps irradiate on the blanking time duration. The flicker effect is effectively reduced for the human eye with the control of the lamp according to the paper describe.

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